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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/776,146	02/10/2004	Lawrence C. Gunn III	LUX-P020	3066

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Fernandez & Associates, LLP
PO Box D
Menlo Park, CA 94026-6402

EXAMINER	
SONG, SARAH U	
ART UNIT	**PAPER NUMBER**
2874	

DATE MAILED: 02/22/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/776,146	GUNN ET AL.	
	Examiner	**Art Unit**	
	Sarah Song	2874	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *06 December 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-97* is/are pending in the application.

4a) Of the above claim(s) *57-97* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-31 and 33-56* is/are rejected.

7)☒ Claim(s) *32* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *10 February 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *0204,0305*.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

1. Claims 57-97 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected invention, there being no allowable generic or linking claim. Election was made **without** traverse in the reply filed on December 6, 2005.

2. Applicant's election without traverse of claims 1-56 in the reply filed on December 6, 2005 is acknowledged.

Information Disclosure Statement

3. The prior art documents submitted by the applicant in the Information Disclosure Statement filed on February 26, 2004 and March 3, 2005 have all been considered and made of record (note the attached copy of form PTO-1449).

Claim Objections

4. Claims 8, 38 and 51 are objected to because of the following informalities: "the complementary error function" in line 3 lacks proper antecedent basis. Appropriate correction is required.

5. Claims 47, 48 and 52 are objected to because of the following informalities: "the grating width" lacks proper antecedent basis ("said widths" previously recited in claim 45). Appropriate correction is required.

6. Claim 32 is objected to because of the following informalities: the usage of "it" in the claim language is objected to. Appropriate correction is required.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

8. **Claims 1-13, 15-29, 31, 33-43 are rejected under 35 U.S.C. 103(a) as being unpatentable over Deliwala (U.S. Patent Application Publication 2003/0039430) in view of Nozaki (JP 01-107213 A).**

9. Regarding claims 1, 19 and 31, Deliwala discloses a waveguide grating coupler for coupling light between a waveguide and an optical element having a substantially Gaussian mode profile, said waveguide grating coupler, comprising:

> a planar guiding portion 7206 optically connected to said waveguide, said planar guiding portion having first and second ends and an optical power distribution therein that decreases between said first and second ends; and
>
> a plurality of elongate scattering elements 112 (¶0426).

10. Deliwala does not expressly disclose the scattering elements having respective scatter cross-sections arranged along at least a portion of said planar guiding portion to couple light having a substantially Gaussian intensity distribution between said planar guiding portion and said optical element, said elongate scattering elements having at least one characteristic which varies in magnitude among at least a group of said elongate scattering elements, said magnitude of said characteristic controlling at least in part said scatter cross-sections of said elongate scattering elements, wherein said magnitude of said characteristic of said group of elongate

scattering elements varies irregularly, said magnitude for said group of elongate scattering elements changing with position along said planar guiding portion at a rate that is discontinuous, wherein said magnitude of said characteristic for said plurality of elongate scattering elements varies non-linearly with position along said planar guiding portion, and a plot of the magnitudes of said characteristic associated with said plurality of elongate scattering elements versus position along said guiding portion includes at least one elongate scattering element substantially offset from a single exponential or Gaussian that is fit to said plot, or wherein said elongate scattering elements are relatively positioned to provide said substantially Gaussian intensity distribution of said coupled light and said decay of said optical power distribution in said coupler.

11. Nozaki discloses a grating coupler 21 comprising scattering elements having respective scatter cross-sections arranged along at least a portion of said planar guiding portion to couple light having a substantially Gaussian intensity distribution between said planar guiding portion and said optical element, said elongate scattering elements having at least one characteristic which varies in magnitude among at least a group of said elongate scattering elements, said magnitude of said characteristic controlling at least in part said scatter cross-sections of said elongate scattering elements, wherein said magnitude of said characteristic of said group of elongate scattering elements varies irregularly, said magnitude for said group of elongate scattering elements changing with position along said planar guiding portion at a rate that is discontinuous, wherein said magnitude of said characteristic for said plurality of elongate scattering elements varies non-linearly with position along said planar guiding portion, and a plot of the magnitudes of said characteristic associated with said plurality of elongate scattering

elements versus position along said guiding portion includes at least one elongate scattering element substantially offset from a single exponential or Gaussian that is fit to said plot, and said scatter cross-section depending on the magnitude of the characteristic as defined by a non-monotonically varying relationship between said scatter cross-section and said magnitude, wherein said elongate scattering elements are relatively positioned to provide said substantially Gaussian intensity distribution of said coupled light and said decay of said optical power distribution in said coupler. See Abstract and Figure 3.

12. Deliwala and Nozaki are analogous art as pertaining to waveguide grating couplers.

13. It would have been obvious to one having ordinary skill in the art at the time the invention was made to provide the grating coupler of Deliwala with the structure and characteristics as shown by Nozaki for the purpose of providing a Gaussian profile for optimal coupling characteristics to the optical element.

14. Regarding claims 2, 20 and 34, the optical element comprising an optical fiber is not expressly disclosed. However, optical fibers coupled to waveguide grating couplers are well known in the art. Therefore, an optical fiber would have been obvious for providing efficient light transmission to remote devices.

15. Regarding claims 3 and 21, said magnitude of said characteristic changes with position along said planar grating portion so as to provide an optical output substantially matching said Gaussian mode profile of said optical element.

16. Regarding claims 4, 5, 23, 33 and 35, said rate of change in magnitude of said characteristic for said group of elongate scattering elements both increases and decreases between said first and second ends. That is, the non-monotonically varying relationship between

said scatter cross-section and said magnitude has portions with negative slope and portions with positive slope.

17. Regarding claims 6, 25 and 36, said planar guiding portion has sidewalls to confine light in a transverse direction (interface of 7206 and 7208).

18. Regarding claims 7, 26 and 37, said planar guiding portion is selected from the group consisting of a channel waveguide, a ridge waveguide, a strip loaded waveguide, and a strip loaded waveguide having a low index transition region.

19. Regarding claims 8 and 38, said optical power distribution decreases between said first and second ends of said planar guiding portion substantially in accordance with a relationship.

20. Regarding claims 9, 27 and 39, said at least one characteristic is selected from the group consisting of grating width, grating height, grating spacing, grating depth, and index of refraction of said elongate scattering elements.

21. Regarding claims 10, 22 and 40, the plot of the magnitudes of said characteristic associated with said group of elongate scattering elements versus position along said guiding portion (Figure 3 of Nozaki) includes more than two elongate scattering elements substantially offset from a single exponential or Gaussian function that is fit to said plot.

22. Regarding claims 11, 24 and 41, the plurality of elongate scattering elements comprises at least 20 elongate scattering elements.

23. Regarding claims 12, 28 and 42, it appears that said magnitude of said characteristic at different positions along said planar grating is selected such that the variation F(z) in scatter cross-sections of the group of elongate scattering elements as a function of longitudinal distance across the group of elongate scattering elements satisfies the following relationship: G(z) = F(z)

E(z) where G(z) corresponds to said substantially Gaussian mode profile of said optical element, and E(z) corresponds to optical power distribution that decreases between said first and second ends.

24. Regarding claims 13, 29 and 43, said waveguide grating coupler couples a substantially planar wave between said waveguide and said optical element, said substantially planar wave oriented at an angle with respect to said planar guiding portion, said elongate scattering elements in said planar guiding portion having spacing selected to scatter light within said waveguide out of said planar guiding portion into a beam directed at said angle.

25. Regarding claims 15-18, Deliwala discloses the waveguide grating coupler further comprises a substrate, said planar guiding portion being disposed over said substrate, wherein said substrate comprises a silicon wafer, said substrate further comprises a silicon dioxide layer formed on said silicon wafer, and said substrate further comprises one or more layers of material formed on said silicon wafer (¶0426).

26. **Claims 1, 14, 19, 30, 31 and 44-56 are rejected under 35 U.S.C. 103(a) as being unpatentable over Deliwala (U.S. Patent Application Publication 2003/0039430) in view of Li et al. (U.S. Patent 5,657,407).**

27. Regarding claims 1, 19, 31 and 45, Deliwala discloses a waveguide grating coupler for coupling light between a waveguide and an optical element having a substantially Gaussian mode profile, said waveguide grating coupler, comprising:

> a planar guiding portion 7206 optically connected to said waveguide, said planar guiding portion having first and second ends and an optical power distribution therein that decreases between said first and second ends; and

a plurality of elongate scattering elements 112 (¶0426).

28. Deliwala does not expressly disclose the scattering elements having respective scatter cross-sections arranged along at least a portion of said planar guiding portion to couple light having a substantially Gaussian intensity distribution between said planar guiding portion and said optical element, said elongate scattering elements having at least one characteristic which varies in magnitude among at least a group of said elongate scattering elements, said magnitude of said characteristic controlling at least in part said scatter cross-sections of said elongate scattering elements, wherein said magnitude of said characteristic of said group of elongate scattering elements varies irregularly, said magnitude for said group of elongate scattering elements changing with position along said planar guiding portion at a rate that is discontinuous, wherein said magnitude of said characteristic for said plurality of elongate scattering elements varies non-linearly with position along said planar guiding portion, and a plot of the magnitudes of said characteristic associated with said plurality of elongate scattering elements versus position along said guiding portion includes at least one elongate scattering element substantially offset from a single exponential or Gaussian that is fit to said plot, wherein said elongate scattering elements are relatively positioned to provide said substantially Gaussian intensity distribution of said coupled light and said decay of said optical power distribution in said coupler, or wherein said elongate scattering elements having widths which vary in magnitude among at least some of said elongate scattering elements, said widths controlling at least in part said scatter cross-sections of said elongate scattering elements as defined by a relationship between widths and scatter cross-sections, said relationship including at least two widths that provide substantially similar scatter cross-sections, wherein said elongate scattering elements are

relatively positioned to provide said substantially Gaussian intensity distribution of said coupled light and said decrease of said optical power distribution in said coupler.

29. Li et al. discloses a grating coupler comprising scattering elements having respective scatter cross-sections arranged along at least a portion of said planar guiding portion to couple light having a substantially Gaussian intensity distribution between said planar guiding portion and said optical element, said elongate scattering elements having at least one characteristic which varies in magnitude among at least a group of said elongate scattering elements, said magnitude of said characteristic controlling at least in part said scatter cross-sections of said elongate scattering elements, wherein said magnitude of said characteristic of said group of elongate scattering elements varies irregularly, said magnitude for said group of elongate scattering elements changing with position along said planar guiding portion at a rate that is discontinuous, wherein said magnitude of said characteristic for said plurality of elongate scattering elements varies non-linearly with position along said planar guiding portion, and a plot of the magnitudes of said characteristic associated with said plurality of elongate scattering elements versus position along said guiding portion includes at least one elongate scattering element substantially offset from a single exponential or Gaussian that is fit to said plot, said scatter cross-section depending on the magnitude of the characteristic as defined by a non-monotonically varying relationship between said scatter cross-section and said magnitude, wherein said elongate scattering elements are relatively positioned to provide said substantially Gaussian intensity distribution of said coupled light and said decay of said optical power distribution in said coupler, and wherein said elongate scattering elements having widths which vary in magnitude among at least some of said elongate scattering elements, said widths

controlling at least in part said scatter cross-sections of said elongate scattering elements as defined by a relationship between widths and scatter cross-sections, said relationship including at least two widths that provide substantially similar scatter cross-sections, wherein said elongate scattering elements are relatively positioned to provide said substantially Gaussian intensity distribution of said coupled light and said decrease of said optical power distribution in said coupler. See Figure 2.

30. Deliwala and Li et al. are analogous art as pertaining to waveguide grating couplers.

31. It would have been obvious to one having ordinary skill in the art at the time the invention was made to provide the grating coupler of Deliwala with the structure and characteristics as shown by Li et al. for the purpose of providing a Gaussian profile for optimal coupling characteristics to the optical element.

32. Regarding claims 14, 30, 44 and 56, said elongate scattering elements in said planar guiding portion have non-uniform spacing selected to scatter light within said waveguide out of said planar guiding portion into a beam having a desired beam shape.

33. Regarding claim 46, the optical element comprising an optical fiber is not expressly disclosed. However, optical fibers coupled to waveguide grating couplers are well known in the art. Therefore, an optical fiber would have been obvious for providing efficient light transmission to remote devices.

34. Regarding claim 47, said magnitude of said width changes with position along said planar grating portion so as to provide an optical output substantially matching said Gaussian mode profile of said optical element.

35. Regarding claim 48, said magnitude of said widths both increases and decreases between said first and second ends.

36. Regarding claim 49, said planar guiding portion has sidewalls to confine light in a transverse direction (interface of 7206 and 7208).

37. Regarding claim 50, said planar guiding portion is selected from the group consisting of a channel waveguide, a ridge waveguide, a strip loaded waveguide, and a strip loaded waveguide having a low index transition region.

38. Regarding claim 51, said optical power distribution decreases between said first and second ends of said planar guiding portion substantially in accordance with a relationship.

39. Regarding claims 52 and 53, Li et al. does not expressly disclose a plot of the magnitudes of said characteristic associated with said widths versus position along said guiding portion containing more than two elongate scattering elements substantially offset from a single exponential or Gaussian function that is fit to said plot, or at least 20 elongate scattering elements. However, the modifications would have been obvious for the purpose of optimizing the grating structure for achieving the Gaussian beam profile.

40. Regarding claim 54, it appears that said magnitude of said characteristic at different positions along said planar grating is selected such that the variation F(z) in scatter cross-sections of the group of elongate scattering elements as a function of longitudinal distance across the group of elongate scattering elements satisfies the following relationship: G(z) = F(z) E(z) where G(z) corresponds to said substantially Gaussian mode profile of said optical element, and E(z) corresponds to optical power distribution that decreases between said first and second ends.

41. Regarding claim 55, said waveguide grating coupler couples a substantially planar wave between said waveguide and said optical element, said substantially planar wave oriented at an angle with respect to said planar guiding portion, said elongate scattering elements in said planar guiding portion having spacing selected to scatter light within said waveguide out of said planar guiding portion into a beam directed at said angle.

Allowable Subject Matter

42. Claim 32 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

43. The following is a statement of reasons for the indication of allowable subject matter: the prior art of record does not disclose or fairly suggest said non-monotonically varying relationship between said scatter cross-section and said magnitude to be oscillatory such that it has a plurality of local extrema.

Conclusion

44. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Sarah Song whose telephone number is 571-272-2359. The examiner can normally be reached on M-Th 7:30am - 6:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Rodney Bovernick can be reached on 571-272-2344. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Sarah N Song

Sarah Song
Primary Examiner
Group Art Unit 2874